

Modern Pollen Deposition Under Vegetation of the Blue Mountains, New South Wales

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Pollen was extracted from surface samples of swamp sediments and soils under various types of vegetation in the catchments of these swamps. The pollen assemblages in these surface samples were compared with the floristic composition of the vegetation to provide a means of interpreting the assemblages of fossil pollen retrieved from the swamp sediments.

The surface pollen assemblages reflected the local vegetation, indicating more/less tree cover, swamp and/or adjacent dryland environment and local flora diversity. All the evidence pointed to very local deposition and little long distance dispersal of pollen. A number of different units may be defined within the one major vegetation type, dry sclerophyll forest/woodland in this case, but the floristics of the units are too similar to allow discrimination of them from their modern pollen assemblages.

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KEYWORDS: Blue Mountains, local pollen deposition, long distance pollen dispersal, modern pollen deposition, pollen spectra.

INTRODUCTION

Pollen is deposited in sediments by the contemporaneous vegetation, but a number of factors affect the representation of each taxon in the sediments so that it is not possible to relate a fossil pollen assemblage in a deposit directly to the vegetation that produced it. Pollen productivity, dispersal and preservation are the main factors that influence representation of a taxon, and each of these factors are in turn influenced by the local environmental conditions. Pollen deposited from under known plant communities, however, may be used to characterize that community and hence assist in the interpretation of pollen spectra recovered from swamp sediments. The nature of pollen deposition of individual taxa may also be deduced from the surface pollen spectra.

Sites for a study of the history of the vegetation were chosen from swamps in an altitudinal sequence in the Blue Mountains (Fig. 1). These sites are situated on a relatively uniform substrate, sandstone, within dry sclerophyll woodland/open forest. Observations of modern pollen deposition are reported in this paper, and the Holocene history of the vegetation from the swamps is reported in Chalson and Martin (this volume).

THE STUDY SITES

The Blue Mountains are a deeply dissected plateau rising from the Cumberland Plain in the east. The plateau surface is undulating and small creeks form upland valleys. Where the underlying rock type is Hawkesbury Sandstone, the upland valleys become incised and develop into V-shaped gorges. In the west where rock type is Banks Wall sandstone, the valley sides and floors slope gently and the streams flow through a series of swamps (Chalson, 1991).

The swamps chosen for study are as follows (see Fig. 1) and the species found at each site are listed in Appendix 1:

Burralow Creek Swamp, at 33° 32'S, 150° 38'E and 310-330 m altitude, is a narrow swamp that follows the creek for some 3.5 km. The upper end of the swamp is 2 km southeast of Kurrajong Heights. The core site is 1 km downstream from the northern end. There are few cleared areas near the swamp, the nearest being over 2 km away.

The vegetation around Burralow Creek is open forest, woodland and swamps (Keith and Benson,

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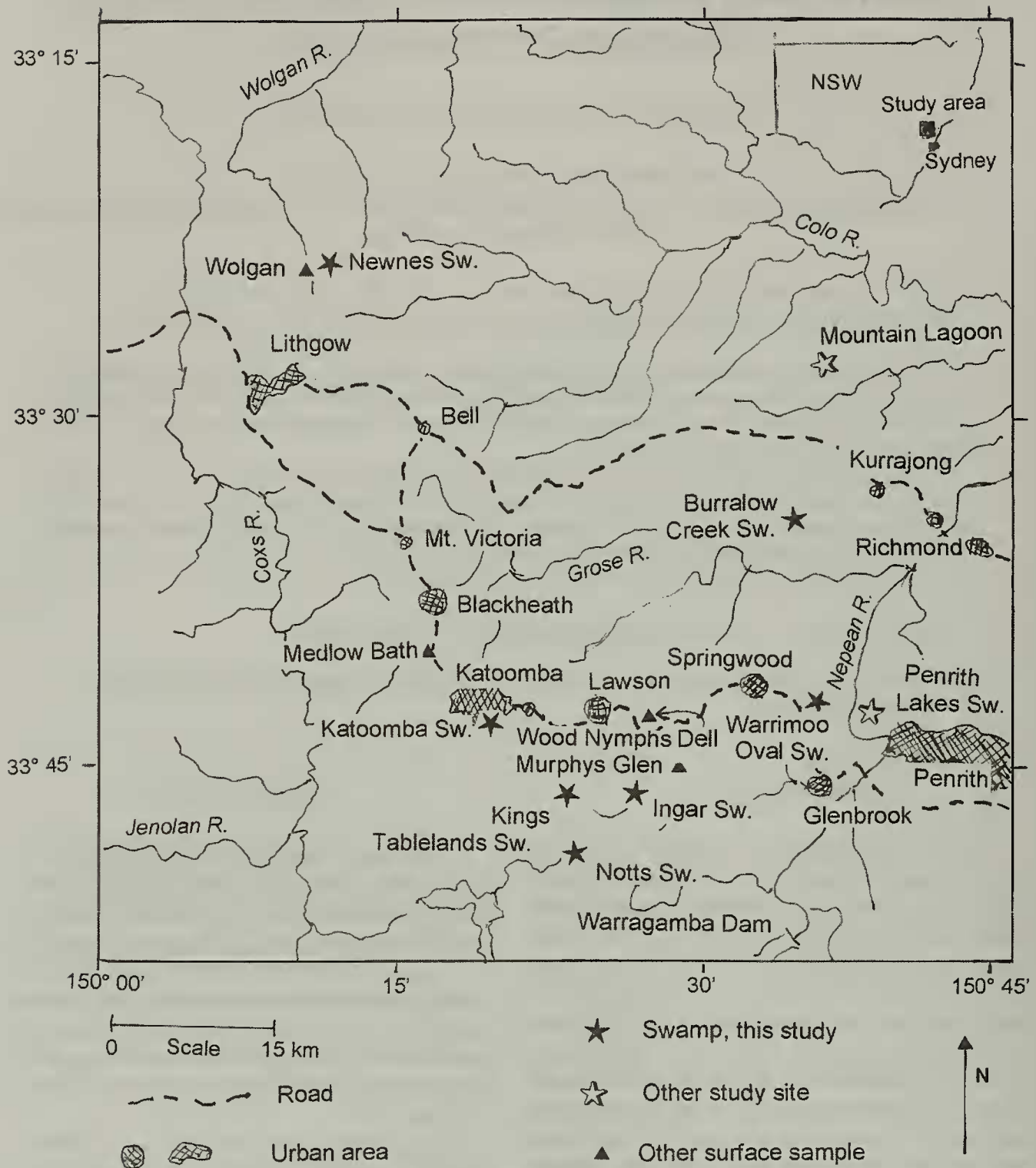


Figure 1. Locality map

1988). *Angophora bakeri*, *A. costata*, *Corymbia eximia*, *Eucalyptus eugenioides*, *E. multicaulis*, *E. pauciflora* and *E. radiata* are locally dominant with a few kilometers of the swamp. The surface of the swamp supports an open heathland of *Leptospermum polygalifolium*, *L. trinervium* and *Eleocharis spachelata*. Nomenclature follows Harden (1992; 1993; 2000; 2002) and PlantNet (2006)

Warrimoo Oval Swamp, at 33° 43' 21.44"S, 150° 36' 58.35"E and 190-200 m altitude, is approximately 1.5 km east of Warrimoo Post office and 0.4 km south of Warrimoo Oval. There are substantial urban areas within a kilometer of the swamp and weed invasion is considerable.

The vegetation is mainly woodland with some open forest and swamp communities (Keith and Benson, 1988). Locally, *Angophora bakeri*,

Eucalyptus pauciflora and *E. radiata* are dominant. The swamp surface supports an open heathland with *Leptospermum* spp.

Notts Swamp, at 33° 48' 35.44" S, 150° 24' 27.66" E and about 682 m altitude is approximately 12 km south-southeast of Wentworth Falls and to the west of Notts Hill. The lower third of the swamp is used as a market garden, but there is no sign of disturbance or weed invasion at the study site. There is no indication of European activities in the catchment upstream of the study site and the nearest settlement is some 7 km to the north-northeast.

The major plant community is open woodland and there is a little open forest and some swamps (Keith and Benson 1988). *Eucalyptus eugenioides*, *E. multicaulis*, *E. piperita*, *E. racemosa* and *E. sieberi* are locally dominant. The swamp supports a closed sedgeland of *Gymnoschoenus sphaerocephalus*, *Leptospermum trinervium* and *Baloskion australe*.

Ingar Swamp, at 33° 46' 11.65" S, 150° 27' 22.92" E and 584 m altitude, is approximately 8 km southeast of Lawson. European settlement is some five km to the northeast, along the highway, and includes some very large, old conifer trees.

The vegetation is mainly woodland with *Corymbia gummifera*, *Eucalyptus oblongata*, *E. piperita*, *E. pauciflora*, and *Angophora costata* dominant locally. Open forest in gorges along the creeks is dominated by *E. eugenioides*, *E. sclerophylla*, *Tristania neriifolia* and *Angophora costata*. The swamp community is a closed sedgeland of *Gymnoschoenus sphaerocephalus*, *Leptocarpus tenax*, *Baumea* sp., *Chorizandra* sp., *Baloskion australe* and, towards the edge, *Hakea teretifolia*, *H. dactyloides* and *Leptospermum lanigerum*.

Kings Tablelands, at 33° 45' 47" S, 150° 22' 43" E and about 780-790 m altitude, is located in small valley off Queen Victoria Creek. It is about 0.6 km east of Queen Victoria Memorial Hospital near Wentworth Falls. An urban area is found less than 1 km to the west where exotic conifers have been planted in the gardens.

The vegetation is mainly open forest around the study site, with woodland on the ridges and closed sedgelands in the swamps (Keith and Benson, 1988). Locally, *Eucalyptus dives*, *E. oreades*, *E. sieberi* and *E. piperita* are dominant in the open forest and *Corymbia gummifera*, *E. racemosa* and *E. sieberi* are dominant in the woodland. On the exposed plateau to the northeast, the dominants in an open heathland are *Allocasuarina distyla*, *E. ligustrina*, *E. stricta*,

Banksia serrata and *Hakea teretifolia*. The dominants on the swamp are *Leptospermum juniperinum* and *L. grandiflorum*.

Katoomba Swamp, at 33° 43' 03" S, 150° 19' 18" E and 950 m altitude, is 1 km east northeast of Katoomba Post Office and 1 km west of Leura Post Office. This swamp is surrounded by urban activity, with drainage ditches and a sealed road running across the swamp. Much of the swamp is (or has been) used for yards for light industry and horse paddocks. Housing extends to the edge of the swamp.

Most of the area around the swamp has been cleared but there are a few remnant pockets of Sandstone Plateau Forest (Keith and Benson, 1988) remaining. *Eucalyptus acmenoides*, *E. oreades*, *E. stellulata*, *E. oblongata* and *E. sieberi* are dominant. The understorey is problematic as the remnant stands are heavily weed infested.

Little remains of the original vegetation over the swamp surface and species of Poaceae are predominant. A small patch of swamp edge vegetation forms a dense thicket of *Leptospermum juniperinum* and *L. scoparium*.

Newnes Swamp, at 33° 22' 57" S, 150° 13' 20" E and 1,060 m altitude, is within a forestry area with pine plantations. Regular burning maintains fire breaks.

Woodland communities are found around the swamp (Benson and Keith, 1990) but the shrub layer has been much reduced by frequent burning. Shrubs remaining on the swamp include *Leptospermum trinervium* and *Grevillea acanthifolia*. A ground cover of grasses is found in all but the wettest areas where Juncaceae and Restionaceae are dominant.

METHODS

The vegetation units at each site were determined from maps in Benson (1992), Keith and Benson (1988) and Benson and Keith (1990). Each site was visited, the vegetation checked with the maps and as many species as possible were identified in each of the vegetation units. Since palynology cannot reveal the structure of the vegetation, the focus of survey was on the species list. Dominance was determined subjectively from the abundance of the species

Samples from the surface of the soil, or where possible, from moss polsters, were collected from the centre of the swamp, the swamp edge and the plant communities adjacent or local to, the swamp sites. Samples were taken from at least 100 m away from community boundaries where possible. The sample types and vegetation are listed in Table 1 and the

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Table 1 Surface samples used for pollen spectra presented in Figs 2 and 3. Codes for vegetation map units are from Keith and Benson (1988).

Surface sample no.	Vegetation	Vegetation map unit	Sample material
Burralow Creek			
1	Open sedgeland mid-swamp	28a	Soil
2	Open sedgeland mid-swamp	28a	0 cm core
3	Swamp fringe	28a	Soil
4	Low Woodland	10ar	Soil
5	Open forest	10ag	Soil
Warrimoo Oval			
6	Closed sedgeland mid-swamp	26a	Soil
7	Closed sedgeland mid-swamp	26a	0 cm core
8	Closed sedgeland swamp fringe	26a	Soil
9	Low woodland	10ar	Soil
Notts			
10	Closed sedgeland mid-swamp	26a	Soil
11	Closed sedgeland swamp fringe	26a	Soil
Ingar			
12	Closed sedgeland mid-swamp	26a	Soil
13	Closed sedgeland swamp fringe	26a	Soil
14	Low woodland	10ar	Soil
15	Low woodland	10ar	Soil
Kings Tableland			
16	Closed sedgeland mid-swamp	26a	0 cm core
17	Closed sedgeland swamp fringe	26a	Soil
18	Low woodland	10ar	Soil
19	Low woodland	10ar	Soil
20	Open forest	9i	Soil
21	Open forest	9i	Soil
22	Open heath	21f	Soil
Katoomba			
23	Closed sedgeland mid-swamp	26a	Soil
24	Closed sedgeland swamp fringe	26a	Soil
25	Open forest	9i	Soil
26	Open forest	9i	Soil
Newnes			
27	Closed heath mid-swamp	20a	Moss
28	Closed heath swamp fringe	20a	Moss
29	Woodland	10f/11a	Moss
30	Woodland	10f/11a	Moss
31	Woodland	10f/11a	Soil
32	Woodland	10f/11a	Soil
33	Open heath	21d	Soil
34	Open heath	21c	Soil
35	Forest	10f	Soil
36	Forest	10f	Soil
Murphys Glen			
37	Tall open forest	6c	Soil
38	Tall open forest	6c	Soil
Wolgan			
39	Open woodland	11a	Soil
40	Open woodland	11a	Soil
Wood Nymphs Dell			
41	Open forest	10ag	Soil
Medlow Bath			
42	Open forest	9i	Soil

study sites are shown in Fig. 1

Six to ten sub-samples were taken from each plant community over a transect of approximately 20 m. The sub-samples were mixed together to reduce the possible over-representation of any one species due to close proximity to an individual plant (Chalson, 1991).

The samples were treated with hydrochloric and hydrofluoric acids to remove siliceous material (Birks and Birks, 1980), oxidised with Schultz solution (a saturated solution of potassium perchlorate in nitric acid), cleared in 10% potassium carbonate and the residue was mounted in glycerine jelly (Brown, 1960).

Pollen was identified by comparing the grains with reference pollen treated with standard acetolysis (Moore et al., 1991). Grains were counted along transects across the slides and tests showed that a count of 140 grains adequately sampled the residues. The counts of each pollen type were presented as percentages of the total count on the pollen diagrams.

RESULTS

Fig. 2 presents the pollen spectra from vegetation on the swamp surface and at the edge of the swamp, and Fig 3. presents spectra from the dry-land communities in the surrounding vegetation. Table 2 presents the name on the pollen diagram, the probable source of the pollen in the vegetation and ecological inference.

Preservation, although adequate, was not good enough for the identification of *Eucalyptus* species beyond broad groups (Chalson and Martin, 1995). The pollen from moss polsters may be better preserved than that from the soil, but moss polsters were not common and usually dried out severely in the forest environment, hence soil samples were usually collected in all but the dampest areas.

Exotic *Pinus* is present in all samples (Figs 2A, 3B) and values are highest at sites near urban areas (Kings Tableland, Katoomba). Surprisingly, *Pinus* values are not high at Newnes, in the forestry area with pine plantations, but the pines were very young at the time of this study.

Angophora/Corymbia and *Eucalyptus/Melaleuca* have been identified in low frequencies in some of the samples which were better preserved. *Melaleuca styphelioides* has been identified in some of the swamp samples (Fig. 2A) where counts may be high. *M. styphelioides* was not found during the survey of the vegetation, but it may be grown in gardens. The

highest count at Warimoo Oval Swamp is close to substantial urban areas. *Leptospermum/Baeckea* has been identified from some swamp samples (Fig. 2A) where counts may be considerable. *Leptospermum* spp. are often dominant in the swamp communities (see Appendix 1)

The unidentified Myrtaceae group is larger than the other groups of Myrtaceae and counts from the swamp samples are the lowest of all. The woodland or forest samples from the borders of the swamp (Fig. 2A) all have higher counts than the swamp samples. Frequencies in samples from the dry-land vegetation (3A) are much higher than those from swamps. Lack of specific identification was generally due to poor preservation.

Casuarinaceae frequencies are usually low, with a few higher values. The highest value (Fig. 3A) comes from heathland vegetation.

Poaceae frequencies are generally low and the high values are associated with urbanisation and disturbance (Katoomba, Fig. 2A).

Restionaceae frequencies are variable but most of the high values are found in the swamp samples. Cyperaceae has not been recorded from many samples, and where it is present, frequencies are generally low, with the few higher frequencies being found in the swamp samples.

Selaginella is present in a few samples and appreciable frequencies may be recorded in some swamp samples. *Gleichenia* may be present in appreciable frequencies in some swamp samples also. Other fern spores are usually recorded in low frequencies and are more common in the dry-land samples.

Table 2 also lists the likely environmental indication of the pollen groups on the diagrams, but this is difficult, given that a group may include many possible species. For example, the families Restionaceae and Cyperaceae include both swamp and dry-land species, but the species in the vegetation and patterns of high pollen frequencies on the diagrams may indicate the nature of the environment when considered together. Thus the species of Restionaceae and Cyperaceae found in the local vegetation (Appendix 1) are almost entirely species of swamps or damp places (Table 2).

DISCUSSION

There are many indications that the pollen recovered from the surface samples was produced mainly by the local vegetation and thus the pollen spectra can indicate the type of

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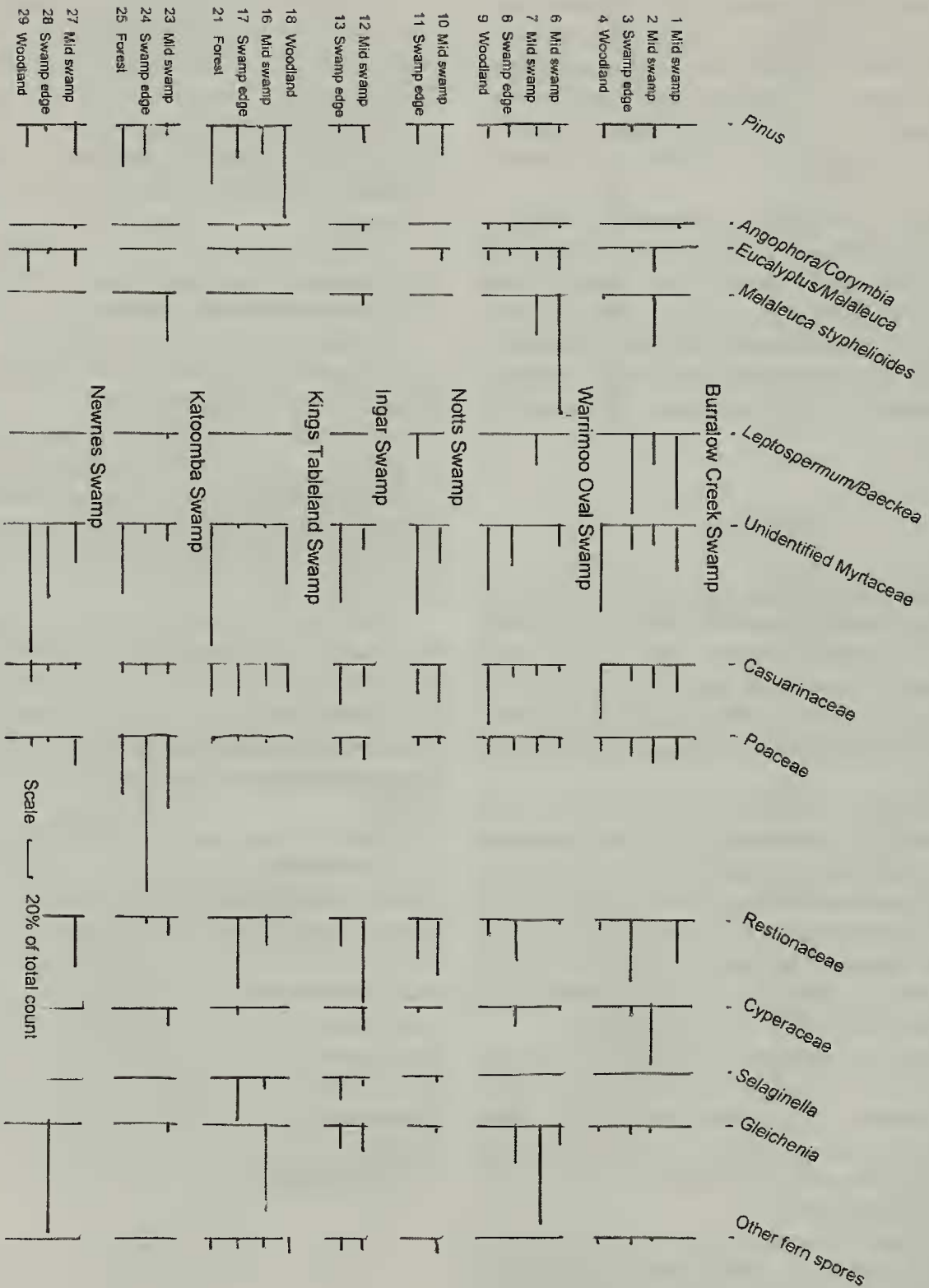


Figure 2A. The pollen spectra from plant communities associated with swamps within major pollen groups. The Sample number (extreme left hand side) refers to the sample in Table 1.

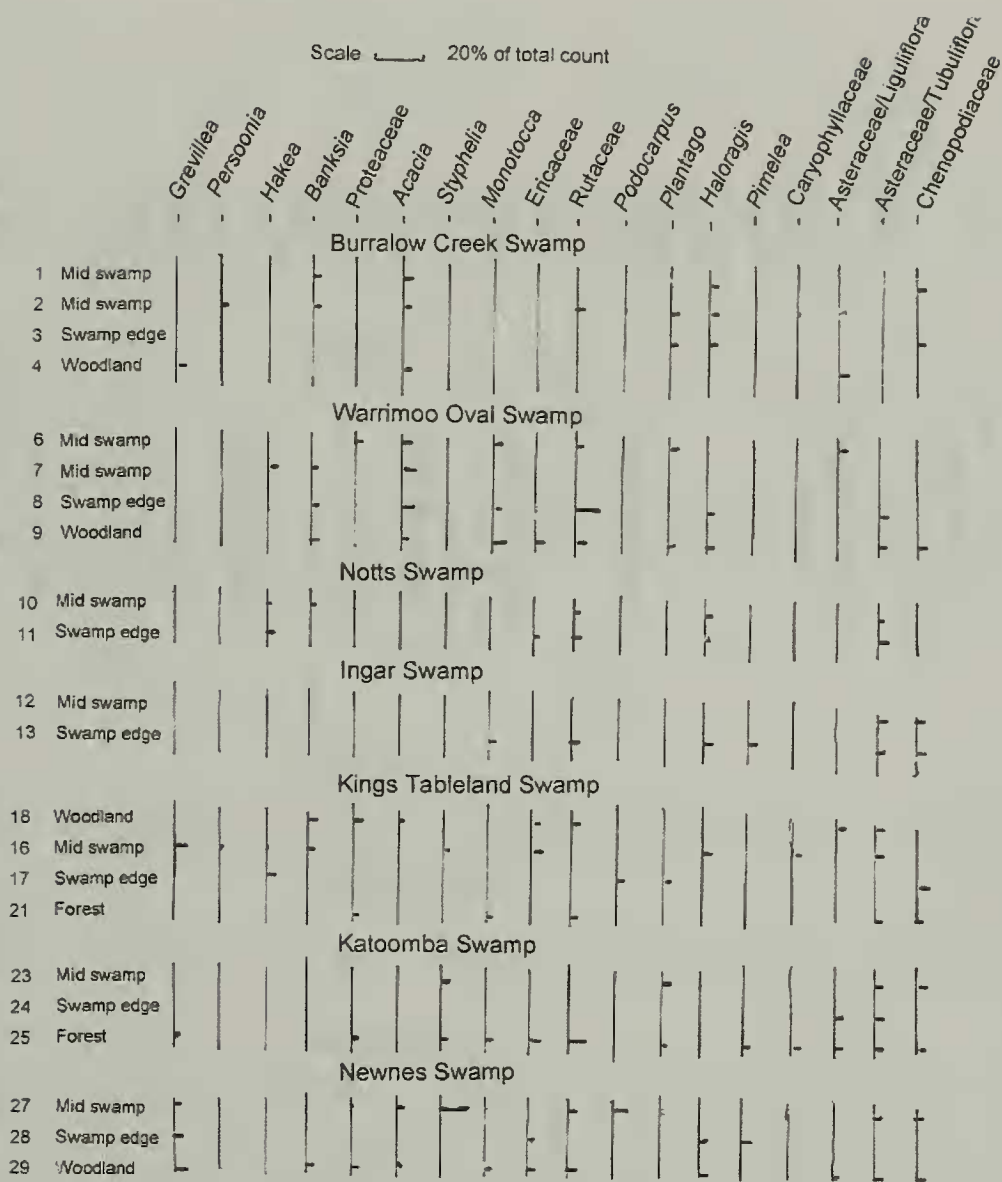


Figure 2B. The pollen spectra from plant communities associated with swamps within low frequency taxa. The Sample number (extreme left hand side) refers to the sample in Table 1

vegetation from which it came. For example, the Myrtaceae pollen content (Figs. 2A, 3A), is lowest from swamp sites, intermediate from the dry-land communities bordering the swamps and highest from the woodland and forest sites away from the swamps, thus inferring a parallel approximate tree cover.

Swamp samples contain much higher pollen frequencies of Restionaceae and/or Cyperaceae than the dry-land sites, although both of these families contain swamp and dry-land species. The species of Restionaceae recorded in the vegetation (Appendix 1) are found on wet and poorly drained soils and in damp to wet heaths (PlantNet, 2007). Most of the species of Cyperaceae, on the other hand, are found in fresh water swamps and swampy areas (Sainty and Jacobs, 1981; PlantNet, 2007), although one dry-land species is also recorded (Appendix 1). Thus high frequencies

of Cyperaceae probably indicate swamps which are more permanently waterlogged than swamps with high frequencies of Restionaceae. Both *Selaginella* and *Gleichenia* are found in wet places, on the edge of swamps and streams (PlantNet, 2007).

The pollen of sclerophyllous shrub taxa (Figs 2B, 3B) are usually found sporadically and in very low frequencies, indicating under-representation and very localised distribution.

These findings are in accord with other studies of surface pollen assemblages which indicate very localised distribution of pollen (Dodson, 1983; Kodala, 1990). Kershaw and Strickland (1990) found that, in a 10 year pollen trapping experiment, most pollen came from within 10 m of the trap.

These study sites are all contained within small valleys where some barrier impedes drainage of the

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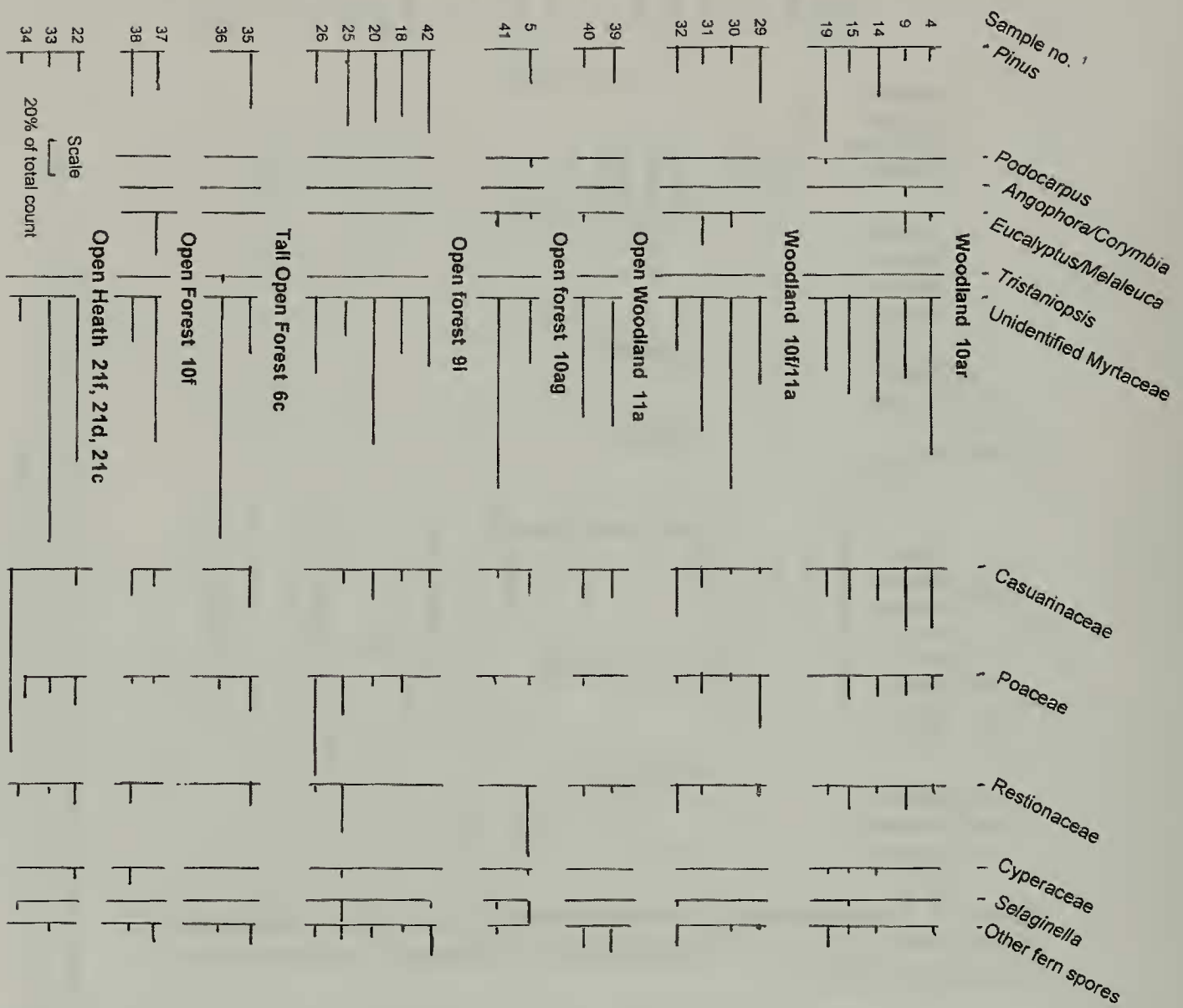


Figure 3A. Pollen spectra associated with dry-land plant communities within major pollen groups. 1 The sample number refers to the sample in Table 1. Codes for the vegetation map units are from Keith and Benson (1988)

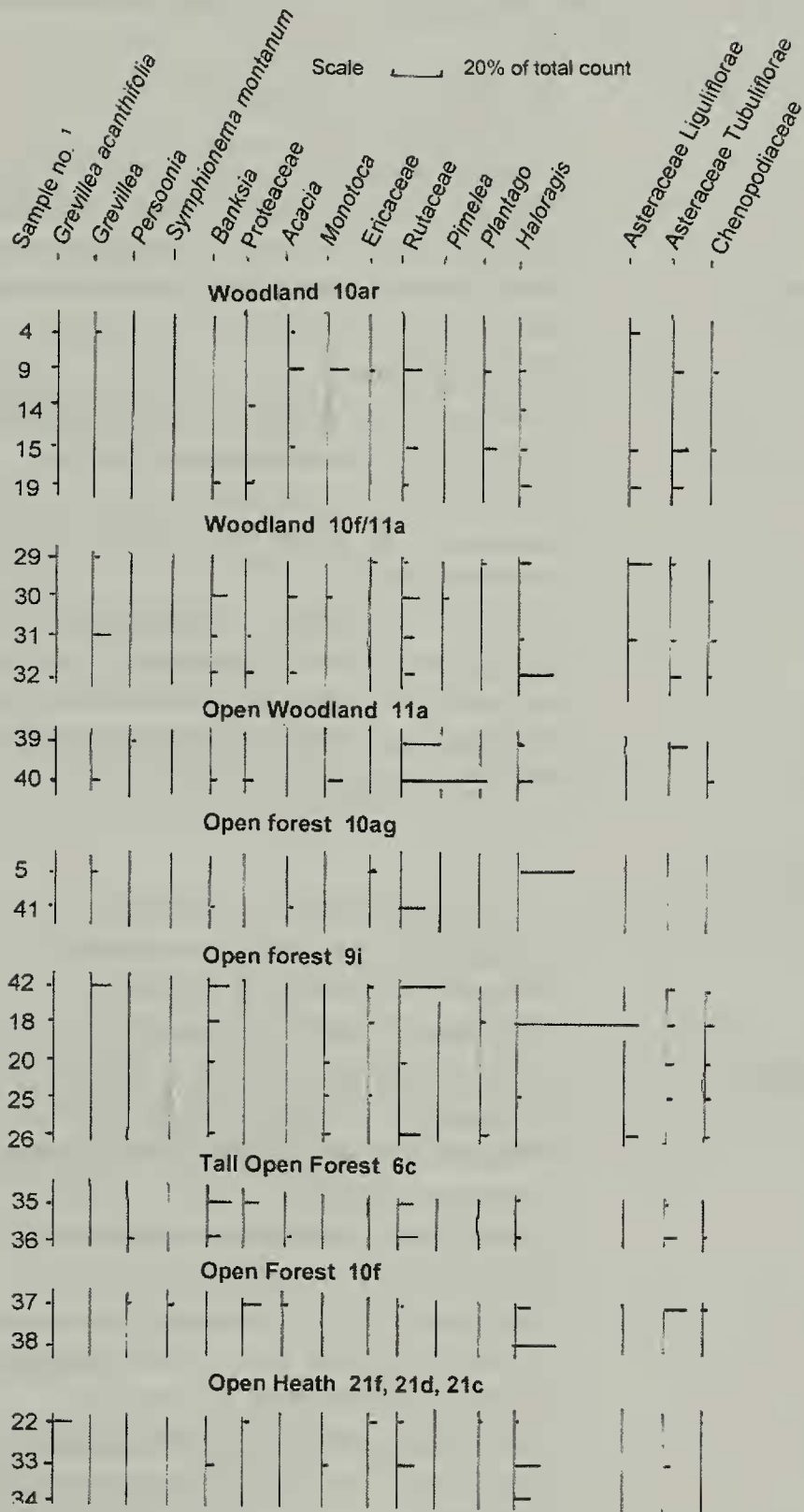


Figure 3B. Pollen spectra associated with dry-land plant communities within low frequency taxa. 1 The sample number refers to the sample in Table 1. Codes for the vegetation map units are from Keith and Benson (1988)

stream and maintains the swamp (for a full description of the sites, see Chalson and Martin, this volume). It may be argued that pollen can be transported a long distance by a stream, to be deposited with the local

assemblage. While this may happen, it has been found that very little pollen is transported into the site so that the assemblage truly reflects the local vegetation (Chmura and Liu, 1990).

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Table 2. Pollen type name on the pollen diagrams (Figs 2, 3) and the probable source in the vegetation.

Name on the pollen diagrams 2A and 3A	Probable source in the vegetation and ecological inference. From Plantnet (2007)
<i>Podocarpus</i>	Probably <i>Podocarpus spinulosus</i> : sclerophyllous shrub/small tree
<i>Pinus</i>	<i>Pinus</i> sp(p), Introduced: Pollen input from urban/forestry areas.
<i>Angophora/Corymbia</i>	Species within the two genera: sclerophyll woodland
<i>Eucalyptus/Melaleuca</i>	Species within the two genera : sclerophyll woodland/forest
<i>Melaleuca styphelioides</i>	<i>Melaleuca styphelioides</i> : moist stream bank habitat
<i>Leptospermum/Baeckea</i>	Species within the two genera: ?mainly swamp communities
<i>Tristaniopsis</i>	<i>Tristaniopsis</i> spp : moist habitats in sclerophyll communities
Unidentified Myrtaceae	All pollen types not identifiable further
Casuarinaceae	<i>Casuarina</i> , <i>Allocasuarina</i> sp(p): <i>A. distyla</i> and <i>A. nana</i> in this study
Poaceae	Native and exotic species in the family: open situations, dryland and swamp species
Restionaceae	All species in the family: swamp and dry land species
Cyperaceae	All species in the family: swamp and dry land species
<i>Selaginella</i>	All species in the genus: damp sites, edge of swamp
<i>Gleichenia</i>	<i>Gleichenia</i> sp(p): damp sites, edge of swamp
Other fern spores	Other ferns: many possible species
Names on 2B and 3B	
<i>Grevillea acanthifolia</i>	<i>G. acanthifolia</i> : sclerophyllous understorey
<i>Grevillea</i>	<i>Grevillea</i> sp(p): sclerophyllous understorey
<i>Hakea</i>	<i>Hakea</i> sp(p): sclerophyllous understorey
<i>Persoonia</i>	<i>Persoonia</i> sp(p): sclerophyllous understorey
<i>Symphionema montanum</i>	<i>S. montanum</i> : heath or dry sclerophyll forest
<i>Banksia</i>	<i>Banksia</i> sp(p): sclerophyllous understorey
Proteaceae	Other taxa in the family sclerophyllous understorey
<i>Acacia</i>	All species in the genus
<i>Styphelia</i>	<i>Styphelia</i> sp(p): sclerophyllous understorey
<i>Monotoca</i>	<i>Monotoca</i> sp(p): sclerophyllous understorey
Ericaceae	Other taxa in the family: sclerophyllous understorey
Rutaceae	All taxa in the family: sclerophyllous understorey
<i>Pimelea</i>	<i>Pimelea</i> sp(p): sclerophyllous understorey
<i>Plantago</i>	<i>Plantago</i> sp(p): native and introduced herbs
<i>Haloragis</i>	<i>Haloragis</i> / <i>Gonocarpus</i> sp(p): Damp sites, sclerophyllous understorey
Asteraceae/Liguliflorae	Fenestrate-grained taxa in the subfamily Liguliflorae: herbs
Asteraceae/Tubuliflorae	Echinate-grained taxa in the subfam. Tubuliflorae: shrubs and herbs
Chenopodiaceae	Ruderals, salt tolerant

It is unfortunate that the Myrtaceae species cannot be identified in most cases, since the vegetation units are defined on their species of Myrtaceae. Most Myrtaceae grains are small and thin-walled (Chalson, 1991; Chalson and Martin, 1995) and the preservation may not be good enough to preserve this fine detail which would distinguish the species. The result is that there are large counts of unidentified Myrtaceae. The alternate wetting and drying at the soil surface in these sclerophyll forests are not ideal conditions for pollen preservation.

The forests, woodlands and heaths defined by Benson (1992), Keith and Benson (1988) and Benson and Keith (1990) are structural units within one major vegetation formation and share many species, although the abundance of a particular species may vary. The pollen assemblages cannot denote structure of the vegetation and the floristics of these units are too similar to allow any differentiation, especially as the Myrtaceae pollen is so poorly preserved. For practical purposes, the surface pollen assemblages can denote major vegetation formations (Birks and Birks, 1980; Moore et al., 1991), more/less catchment tree cover, swamp and/or adjacent dry-land environments and local floral diversity.

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APPENDIX. Species found in the vegetation on and around the swamps. Nomenclature follows Harden (1992; 1993; 2000; 2002) and Plantnet (2006). Vegetation map units are from Keith and Benson (1988) D, dominant. *, introduced species.

BURRALOW CREEK SWAMP Species	Open forest 10ar	Wood- land 10ag	Edge swamp 28a	Mid swamp 28a
BRYOPHYTES				
Sphagnaceae				
<i>Sphagnum</i> sp.			+	
PTERIDOPHYTES AND ALLIES				
Adiantaceae				
<i>Adiantum aethiopicum</i>	+	+		
Blechnaceae				
<i>Blechnum ambiguum</i>			+	
<i>B. cartilaginum</i>		+		
Dennstaediaceae				
<i>Pteridium esculentum</i>		+	+	+
Gleicheniaceae				
<i>Gleichenia dicarpa</i>			+	
<i>G. microphylla</i>	+			
Osmundaceae				
<i>Todea barbara</i>		+		
Selaginellaceae				
<i>Selaginella uliginosa</i>			+	
ANGIOSPERMS, DICOTYLEDONS				
Apiaceae				
<i>Platysace ericoides</i>	+			
<i>P. lanceolata</i>				+
<i>P. linearifolia</i>	+			+
<i>Xanthosia pilosa</i>	+	+		
Apocynaceae				
<i>Parsonsia straminea</i>	+			
Araliaceae				
<i>Polyscias sambucifolia</i>	+	+		
Asteraceae				
<i>Cassinia aculeata</i>	+			
<i>C. aureonitens</i>	+			
Casuarinaceae				
<i>Allocasuarina nana</i>			+	
Ceratophyllaceae				
<i>Ceratophyllum demersum</i>	+			
Cunoniaceae				
<i>Callicoma serratifolia</i>	+			
Dilleniaceae				
<i>Hibbertia acicularis</i>			+	
<i>H. bracteata</i>		+		

Elaeocarpaceae				
<i>Elaeocarpus reticulatus</i>	+			
<i>Tetratheca thymifolia</i>		+		
Ericaceae				
<i>Epacris paludosa</i>	+			
<i>E. pulchella</i>	+	+		
<i>Leucopogon hookeri</i>	+	+		
Euphorbiaceae				
<i>Ampera xiphoclada</i>	+			
<i>Phyllanthus hirtellus</i>	+			+
Fabaceae, Faboideae				
<i>Bossiaea obcordata</i>	+			
<i>Dillwynia floribunda</i>	+		+	+
<i>D. retorta</i>	+			
<i>Gompholobium huegelii</i>		+	+	
<i>Pultenaea tuberculata</i>	+			
Fabaceae, Mimosoideae				
<i>Acacia falciformis</i>	+			
<i>A. myrtifolia</i>	+			
<i>A. obtusata</i>	+			+
<i>A. ptychoclada</i>			+	+
<i>A. terminalis</i>	+		+	
Goodeniaceae				
<i>Dampiera stricta</i>	+		+	
<i>Goodenia dimorpha</i>			+	
<i>G. heterophylla</i>	+			
<i>G. ovata</i>	+			
Lamiaceae				
<i>Prostanthera violacea</i>		+		
Lauraceae				
<i>Cassytha melantha</i>	+			
Lobeliaceae				
<i>Pratia purpurascens</i>			+	
Loganiaceae				
<i>Mitrasacme pilosa</i>				+
Meliaceae				
* <i>Melia azedarach</i> var. <i>australasica</i>	+			
Menyanthaceae				
<i>Villarsia exaltata</i>				+
Myrsinaceae				
<i>Rapanea howittiana</i>	+	+		
Myrtaceae				
<i>Angophora bakeri</i>				D
<i>A. costata</i>	D			
<i>A. floribunda</i>	+	+		

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

<i>Baeckea linifolia</i>			+	
<i>Corymbia eximia</i>			D	
<i>Eucalyptus eugenioides</i>			D	
<i>E. multicaulis</i>			D	
<i>E. pauciflora</i>	D	D		
<i>E. radiata</i>		D		
<i>Kunzea capitata</i>	+			D
<i>Leptospermum polygalifolium</i>			+	
<i>L. trinervium</i>				D
<i>Melaleuca linariifolia</i>	D	D		
<i>Tristania neriifolia</i>	D			
Oleaceae				
* <i>Ligustrum sinense</i>	+			
<i>Notelaea longifolia</i>	+	+		
Pittosporaceae				
<i>Billardiera scandens</i>	+			
Proteaceae				
<i>Banksia ericifolia</i>	+			
<i>B. serrata</i>				+
<i>Hakea teretifolia</i>	+		+	
<i>Lambertia formosa</i>	+	+		
<i>Persoonia laurina</i>			+	
<i>P. levis</i>	+			
<i>P. linearis</i>	+			
<i>P. mollis</i>				+
<i>P. oblongata</i>	+			
<i>Petrophile pulchella</i>		+		
Ranunculaceae				
<i>Clematis aristata</i>		+		
Rhamnaceae				
<i>Cryptandra amara</i>		+		
Rutaceae				
<i>Eriostemon hispidulus</i>	+	+		
Sapindaceae				
<i>Dodonaea pinnata</i>	+			
<i>D. triquetra</i>	+			
Stackhousiaceae				
<i>Stackhousia viminea</i>	+			
Thymelaeaceae				
<i>Pimelea ligustrina</i>	+			
Violaceae				
<i>Viola hederacea</i>		+		
ANGIOSPERMS, MONOCOTYLEDONS				
Cyperaceae				
<i>Baumea juncea</i>				+

<i>Baumea</i> sp.			+	+
<i>Chorizandra</i> sp.	+			+
<i>Eleocharis sphacelata</i>		+	+	
<i>Lepidosperma longitudinale</i>			+	
<i>Schoenus</i> sp.			+	
Lomandraceae				
<i>Lomandra glauca</i>		+		
<i>L. longifolia</i>				+
Phormiaceae				
<i>Dianella caerulea</i>	+			
Restionaceae				
<i>Leptocarpus tenax</i>				+
<i>Baloskion fimbriatum</i>		+		
Smilacaceae				
<i>Smilax australis</i>	+			
<i>S. glyciophylla</i>	+			

WARRIMOO OVAL SWAMP Species	Open forest 10ar	Edge swamp 26a	Mid swamp 26a
PTERIDOPHYTES AND ALLIES			
Adiantaceae			
<i>Adiantum diaphanum</i>	+		
Dennstaediaceae			
<i>Pteridium esculentum</i>	+	+	
Gleicheniaceae			
<i>Gleichenia dicarpa</i>		+	+
ANGIOSPERMS, DICOTYLEDONS			
Apiaceae			
<i>Actinotus minor</i>	+		
<i>Platysace lanceolata</i>	+	+	
<i>P. linearifolia</i>	+		
Ericaceae			
<i>Brachyloma daphnoides</i>	+		
<i>Dracophyllum secundum</i>		+	
<i>Epacris paludosa</i>	+	+	
Fabaceae, Faboideae			
<i>Bossiaea heterophylla</i>	+	+	
* <i>Cytisus scoparius</i>	+		
<i>Daviesia ulicifolia</i>	+	+	
<i>Dillwynia phyllicoides</i>		+	
<i>Gompholobium huegelii</i>	+	+	
<i>G. latifolium</i>	+		
<i>Hovea linearis</i>		+	

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

<i>Mirbelia rubifolia</i>	+		
Fabaceae, Mimosoideae			
<i>Acacia falciformis</i>	+		
<i>A. ptychoclada</i>		+	
<i>A. rubida</i>			+
<i>A. terminalis</i>	+		
Goodeniaceae			
<i>Dampiera stricta</i>	+	+	
<i>G. ovata</i>	+		
Lobeliaceae			
<i>Pratia purpurascens</i>	+		
Myrtaceae			
<i>Angophora bakeri</i>	D	D	
<i>Baeckea linifolia</i>	+		+
<i>Eucalyptus notabilis</i>		D	
<i>E. pauciflora</i>	D		
<i>E. radiata</i>	D		
<i>Kunzea capitata</i>	+		D
<i>Leptospermum grandifolium</i>			D
<i>L. polygalifolium</i>	+		D
<i>L. trinervium</i>	+	+	
Polygalaceae			
<i>Comesperma defoliatum</i>	+		
<i>C. ericinium</i>	+		
Proteaceae			
<i>Banksia ericifolia</i>	+	+	
<i>B. oblongifolia</i>	+		
<i>B. serrata</i>	+	+	
<i>Grevillea laurifolia</i>	+	+	
<i>G. mucronulata</i>	+		
<i>G. phylloides</i>	+	+	
<i>Hakea salicifolia</i>	+	+	
<i>Isopogon anethifolius</i>	+	+	
<i>I. prostratus</i>	+	+	
<i>Persoonia laurina</i>	+		
<i>P. myrtilloides</i>	+		
<i>P. pinifolia</i>	+		
Rutaceae			
<i>Boronia microphylla</i>	+	+	
Thymelaeaceae			
<i>Pimelea glauca</i>			+
<i>P. ligustrina</i>	+		
Violaceae			
<i>Viola hederacea</i>			

ANGIOSPERMS, MONOCOTYLEDONS

Cyperaceae

Baumea juncea +

Eleocharis sphacelata +

Juncaceae

Juncus remotiflorus +

Lomandraceae

Lomandra filiformis ssp *coriacea* +

L. longifolia +

L. obliqua +

Phormiaceae

Dianella caerulea +

Restionaceae

Leptocarpus tenax + +

NOTTS SWAMP

Species

Open
forest
10ar

Mid
swamp
26a

PTERIDOPHYTES AND ALLIES

Dennstaediaceae

Pteridium esculentum +

Gleicheniaceae

Gleichenia dicarpa +

Selaginellaceae

Selaginella uliginosa +

ANGIOSPERMS, DICOTYLEDONS

Apiaceae

Actinotus forsythii +

Platysace lanceolata +

P linearifolia +

Ericaceae

Epacris paludosa +

Lissanthe sapida +

Euphorbiaceae

Poranthera microphylla +

Fabaceae, Faboideae

Bossiaea heterophylla +

Phyllota squarrosa +

Platylobium formosum +

Fabaceae, Mimosoideae

Acacia melanoxylon +

A. obtusata +

A. obtusifolia +

A. stricta +

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

Myrtaceae			
<i>Eucalyptus aggregata</i>			+
<i>E. dives</i>	D		
<i>E. ligustrina</i>	D		
<i>E. pauciflora</i>	D		
<i>E. piperita</i>	D		
<i>E. sclerophylla</i>	D		
<i>Kunzea capitata</i>			D
<i>Leptospermum juniperinum</i>			+
Proteaceae			
<i>Banksia oblongifolia</i>	+		
<i>B. serrata</i>	+		
<i>Grevillea phylicoides</i>	+		
<i>Hakea teretifolia</i>	+		
<i>Isopogon prostratus</i>	+		
<i>Persoonia laurina</i>	+		
<i>P. linearis</i>	+		
<i>Petrophile pedunculata</i>	+		
Rutaceae			
<i>Boronia microphylla</i>	+		+
ANGIOSPERMS, MONOCOTYLEDONS			
Cyperaceae			
<i>Baumea rubiginosa</i>			+
<i>Carex</i> sp.	+		
<i>Gahnia</i> sp.			D
Iridaceae			
<i>Patersonia sericea</i>	+		
Juncaceae			
<i>Juncus remotiformis</i>			+
Phormiaceae			
<i>Dianella caerulea</i>	+		
Poaceae			
<i>Entolasia marginata</i>	+		
<i>Poa</i> sp.	+		
Restionaceae			
<i>Baloskion australe</i>			+
<i>Leptocarpus tenax</i> (Labill.)			D

INGAR SWAMP	Open	Wood-	6c Tall	Edge	Mid
Species	forest	land	open	swamp	swamp
	10ar	10ag	forest	26a	26a

PTERIDOPHYTES AND ALLIES

Adiantaceae

<i>Adiantum aethiopicum</i>				+	
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Dennstaediaceae				
<i>Pteridium esculentum</i>	+		+	
Dicksoniaceae				
<i>Calochlaena dubia</i>			+	
Gleicheniaceae				
<i>Gleichenia dicarpa</i>		+		+
<i>G. microphylla</i>		+		
Osmundaceae				
<i>Todea barbara</i>		+		
Selaginellaceae				
<i>Selaginella uliginosa</i>				+
ANGIOSPERMS, DICOTYLEDONS				
Apiaceae				
<i>Actinotus forsythii</i>	+			+
<i>Platysace lanceolata</i>	+	+	+	
<i>P. linearifolia</i>	+			+
Casuarinaceae				
<i>Allocasuarina distyla</i>		+		
Cunoniaceae				
<i>Bauera rubioides</i>		+		
<i>Callicoma serratifolia</i>		+	+	
<i>Ceratopetalum apetalum</i>		+		
Dilleniaceae				
<i>Hibbertia acicularis</i>	+			
Elaeocarpaceae				
<i>Elaeocarpus reticulatus</i>			+	
Ericaceae				
<i>Brachyloma daphnoides</i>		+		
<i>Dracophyllum secundum</i>				+
<i>Epacris paludosa</i>	+	+		
<i>Leucopogon esquamatus</i>				+
<i>L. hookeri</i>		+		
<i>L. lanceolatus</i>		+		
<i>Lissanthe sapida</i>	+			
Euphorbiaceae				
<i>Ampera xiphoclada</i>	+			
Fabaceae, Faboideae				
<i>Bossiaea heterophylla</i>	+			
<i>B. obcordata</i>		+		
<i>Daviesia alata</i>	+	+		
<i>D. ulicifolia</i>	+			
<i>Dillwynia philicoides</i>		+		
<i>D. retorta</i>	+			
<i>Glycine clandestina</i>	+			
<i>Hovea linearis</i>				+

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

<i>Phyllota phyllicoides</i>	+				
<i>P. squarrosa</i>		+			
<i>Platylobium formosum</i>					+
<i>Pultenaea divaricata</i>		+			
<i>P. flexilis</i>				+	
<i>P. incurvata</i>		+			
<i>P. tuberculata</i>		+	+		
Fabaceae, Mimosoideae					
<i>Acacia echinula</i>	+	+	+		
<i>A. melanoxylon</i>	+				
<i>A. obliquinervia</i>	+				
<i>A. obtusata</i>	+		+		
<i>A. obtusifolia</i>				+	+
<i>A. stricta</i>	+			+	+
<i>A. suaveolens</i>		+	+		
Goodeniaceae					
<i>Dampiera stricta</i>				+	
<i>Goodenia bellidifolia</i>				+	
<i>G. dimorpha</i>				+	
<i>G. ovata</i>				+	
Haloragaceae					
<i>Gonocarpus chinensis</i> ssp <i>verrucosus</i>				+	
<i>G. longifolius</i>			+	+	
Myrtaceae					
<i>Angophora bakeri</i>	D	D	+		
<i>Backhousia myrtifolia</i>				+	
<i>Baeckea diosmifolia</i>		+			
<i>Corymbia eximia</i>	D				
<i>Eucalyptus agglomerata</i>		D			
<i>E. dalrympleana</i>			D		
<i>E. dives</i>		D			
<i>E. obliqua</i>	D				
<i>E. oreades</i>	D				
<i>E. pauciflora</i>	D	D			
<i>E. radiata</i>		D			
<i>E. sieberi</i>	+				
<i>Kunzea capitata</i>	+	+			
<i>Leptospermum grandifolium</i>			+		
<i>L. juniperinum</i>					D
<i>L. polygalifolium</i>		+			+
<i>L. scoparium</i>			+		
<i>L. trinervium</i>			+		
<i>Melaleuca linariifolia</i>			D		
<i>Syncarpia glomulifera</i>		D			

Proteaceae				
<i>Banksia ericifolia</i>				+
<i>B. oblongifolia</i>	+	+		
<i>B. serrata</i>	+	+	+	
<i>Grevillea aspleniifolia</i>		+		
<i>G. laurifolia</i>			+	
<i>G. phyllicoides</i>	+			D
<i>Hakea propinqua</i>			+	
<i>H. sericea</i>		+		D
<i>H. teretifolia</i>	+	+		+
<i>Isopogon prostratus</i>	+	+		
<i>Lambertia formosa</i>		+		
<i>Lomatia myricoides</i>			+	
<i>Persoonia acerosa</i>		+		
<i>P. laurina</i>	+			
<i>P. levis</i>		+		
<i>P. linearis</i>	+	+	+	
<i>P. pinifolia</i>		+		
<i>Petrophile pedunculata</i>	+			
Ranunculaceae				
<i>Clematis aristata</i>			+	
Rhamnaceae				
<i>Cryptandra amara</i>			+	
Rutaceae				
<i>Boronia microphylla</i>	+			
Thymelaeaceae				
<i>Pimelea ligustrina</i>				+
ANGIOSPERMS, MONOCOTYLEDONS				
Cyperaceae				
<i>Baumea rubiginosa</i>				D
<i>Carex</i> sp.	+	+		+
<i>Chorizandra cymbaria</i>				D
<i>Eleocharis sphacelata</i>		+		
<i>Gahnia sieberana</i>		+	+	
<i>Gahnia</i> sp.				D
<i>Gymnoschoenus sphaerocephalus</i>				+
<i>Lepidosperma longitudinale</i>				D
Iridaceae				
<i>Patersonia sericea</i>	+			
Juncaceae				
<i>Juncus remotiformis</i>			+	
Luzuriagaceae				
<i>Eustrephus latifolius</i>			+	
Phormiaceae				
<i>Dianella caerulea</i>	+			

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

Poaceae					
<i>Entolasia marginata</i>	+				
<i>Poa</i> sp.				+	
Restionaceae					
<i>Baloskion australe</i>					+
<i>Empodisma minus</i>				D	
<i>Leptocarpus tenax</i>				D	D
Smilacaceae					
<i>Smilax australis</i>				+	

KINGS TABLELAND SWAMP Species	Wood- land 10ar	Open forest 9i	Open heath 21f	Edge swamp 26a	Mid swamp 26a
PTERIDOPHYTES AND ALLIES					
Dennstaediaceae					
<i>Pteridium esculentum</i>		+			
Gleicheniaceae					
<i>Gleichenia dicarpa</i>					+
GYMNOSPERMS					
Cupressaceae					
<i>Callitris muelleri</i>			+		
ANGIOSPERMS, DICOTYLEDONS					
Apiaceae					
<i>Actinotus forsythii</i>			+		
<i>Platysace lanceolata</i>	+	+	+		
Casuarinaceae					
<i>Allocasuarina distyla</i>		+	D		
<i>Allocasuarina nana</i>			+		
Ericaceae					
<i>Dracophyllum secundum</i>					+
<i>Epacris paludosa</i>			+		
Fabaceae, Faboideae					
<i>Bossiaea heterophylla</i>		+	+		
<i>Daviesia alata</i>	+		+		
<i>D. ulicifolia</i>		+			
<i>Hovea linearis</i>			+		
<i>Phyllota squarrosa</i>	+				
<i>Pultenaea divaricata</i>	+				
Fabaceae, Mimosoideae					
<i>Acacia obtusata</i>		+			
<i>A. stricta</i>		+			
<i>A. suaveolens</i>	+	+			
<i>A. terminalis</i>			+		

Myrtaceae				
<i>Corymbia eximia</i>	D			
<i>C. gummifera</i>			D	
<i>Eucalyptus deanei</i>		D		
<i>E. oblonga</i>		D		
<i>E. pauciflora</i>		D		
<i>E. piperita</i>	D			
<i>E. sclerophylla</i>	D	D		
<i>E. stellulata</i>			D	
<i>E. stricta</i>			+	
<i>Kunzea capitata</i>	+	+		
<i>K. ericoides</i>			+	
<i>Leptospermum grandifolium</i>			+	
<i>L. juniperinum</i>				D
<i>L. polygalifolium</i>			+	D
Olacaceae				
<i>Olax stricta</i>			+	
Proteaceae				
<i>Banksia ericifolia</i>	+		+	+
<i>B. oblongifolia</i>		+	D	
<i>B. serrata</i>	+	+	+	
<i>B. spinulosa</i>				+
<i>Grevillea phylicoides</i>	+	+	+	
<i>Hakea dactyloides</i>			+	
<i>H. salicifolia</i>	+	+		
<i>H. sericea</i>			D	+
<i>Isopogon anemonifolius</i>		+		
<i>I. prostratus</i>	+	+	+	
<i>Lomatia silaifolia</i>			+	
<i>Persoonia laurina</i>	+	+		
<i>Petrophile pedunculata</i>	+		+	
Thymelaeaceae				
<i>Pimelea ligustrina</i>				+
ANGIOSPERMS, MONOCOTYLEDONS				
Lomandraceae				
<i>Lomandra glauca</i>		+		

KATOOMBA SWAMP Species	Open forest Upper 9i	Open forest Lower 9i	Edge swamp 26a	Mid swamp 26a
BRYOPHYTES				
Dawsoniineae				
<i>Dawsonia</i> sp.				D

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

PTERIDOPHYTES AND ALLIES

Blechnaceae

Blechnum cartilaginum +

Dennstaediaceae

Pteridium esculentum + +

Gleicheniaceae

Gleichenia dicarpa +

Lycopodiaceae

Lycopodium deuterodensum +

ANGIOSPERMS, DICOTYLEDONS

Araliaceae

Polyscias sambucifolia + +

Asteraceae

Arrhenechthites mixta +

Bracteantha bracteata +

Cunoniaceae

Callicoma serratifolia +

Ericaceae

Epacris paludosa +

Fabaceae, Faboideae

Bossiaea rhombifolia + + +

Daviesia latifolia +

Fabaceae, Mimosoideae

Acacia obtusata +

A. suaveolens +

Myrtaceae

Callistemon citrinus D

Eucalyptus obliqua D

E. oblonga D

E. sclerophylla D

E. squamosa D

Kunzea capitata + +

K. ericoides D

Leptospermum polygalifolium D

L. trinervium +

Oleaceae

**Ligustrum sinense* + +

Polygonaceae

**Acetosella vulgaris* +

**Rumex obtusifolius* +

Proteaceae

Banksia spinulosa +

Grevillea mucronata +

Isopogon prostratus +

Lomatia myricoides +

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<i>Persoonia laurina</i>					+
<i>Petrophile pedunculata</i>					+
Rutaceae					
<i>Boronia microphylla</i>					+
ANGIOSPERMS, MONOCOTYLEDONS					
Cyperaceae					
<i>Caustis flexuosa</i>					D
Juncaceae					
<i>Juncus remotiformis</i>					+ D
Lomandraceae					
<i>Lomandra obliqua</i>					+
Phormiaceae					
<i>Dianella caerulea</i>					+
Poaceae					
<i>Poa</i> sp.					+

NEWNES SWAMP Species	Open forest 9i	Wood- land 11a	Edge swamp 20a	Mid swamp 20a
PTERIDOPHYTES AND ALLIES				
Blechnaceae				
<i>Blechnum cartilaginum</i>	+			
Dennstaediaceae				
<i>Pteridium esculentum</i>	+			
Gleicheniaceae				
<i>Gleichenia dicarpa</i>	+		+	
ANGIOSPERMS, DICOTYLEDONS				
Apiaceae				
<i>Platysace lanceolata</i>	+			
Asteraceae				
<i>Arrhenechthites mixta</i>	+			
<i>Helichrysum scorpioides</i>	+	+		
<i>Olearia</i> sp. aff. <i>chrysophylla</i>	+			
Casuarinaceae				
<i>Allocasuarina nana</i>		+		
Dilleniaceae				
<i>Hibbertia dentata</i>	+			
Ericaceae				
<i>Brachyloma daphnoides</i>			+	
<i>Epacris obtusifolia</i>			+	
<i>E. paludosa</i>	+		+	
<i>Lissanthe sapida</i>	+	+		
<i>Monotoca scoparia</i>				+

MODERN POLLEN DEPOSITION IN THE BLUE MOUNTAINS

Euphorbiaceae				
<i>Ampera xiphoclada</i>	+			
Fabaceae, Faboideae				
<i>Daviesia corymbosa</i>	+			
<i>D. ulicifolia</i>	+			
<i>Gompholobium grandiflorum</i>		+		
<i>G. latifolium</i>		+		
<i>Phyllota phyllicoides</i>		+		
<i>P. squarrosa</i>	+	+		
<i>Platylobium formosum</i>			+	
Fabaceae, Mimosoideae				
<i>Acacia elata</i>	+			
<i>A. linifolia</i>	+			
<i>A. longifolia</i>		+		
<i>A. melanoxylon</i>		+		
<i>A. suaveolens</i>	+			
Goodeniaceae				
<i>Dampiera stricta</i>	+		+	
Myrtaceae				
<i>Baeckea diosmifolia</i>			+	+
<i>Eucalyptus acmenoides</i>		D		
<i>E. aggregata</i>		D		
<i>E. deanei</i>		D		
<i>E. notabilis</i>	D	D		
<i>E. oreades</i>	D	D		
<i>E. racemosa</i>	D			
<i>E. sclerophylla</i>		D		
<i>Kunzea capitata</i>	+		D	
<i>Leptospermum juniperinum</i>			+	+
<i>L. polygalifolium</i>	+			
Proteaceae				
<i>Banksia spinulosa</i>			+	D
<i>Grevillea acanthifolia</i>	+			
<i>G. asplenifolia</i>	+	+		
<i>G. phyllicoides</i>		+		
<i>Hakea salicifolia</i>	+			
<i>H. teretifolia</i>	+			
<i>Petrophile pedunculata</i>	+	+		
Ranunculaceae				
<i>Clematis aristata</i>	+			
Rhamnaceae				
<i>Cryptandra amara</i>		+		
Rutaceae				
<i>Boronia microphylla</i>		+		

Santalaceae			
<i>Exocarpos strictus</i>		+	
Thymelaeaceae			
<i>Pimelea glauca</i>	+		
<i>P. ligustrina</i>	+		
ANGIOSPERMS, MONOCOTYLEDONS			
Cyperaceae			
<i>Lepidosperma laterale</i>	+		+
Iridaceae			
<i>Patersonia sericea</i>	+	+	
Juncaceae			
<i>Juncus remotiformis</i>			+
Lomandraceae			
<i>Lomandra filiformis</i> ssp <i>coriacea</i>	+	+	
<i>L. filiformis</i> ssp <i>filiformis</i>		+	
<i>L. glauca</i> Ewart	+		
Phormiaceae			
<i>Dianella caerulea</i>		+	
Poaceae			
<i>Entolasia marginata</i>			+
<i>Poa</i> sp.		+	
Restionaceae			
<i>Empodisma minus</i>			+
<i>Leptocarpus tenax</i>		+	+
